

Claims:

1 1. A sealing system which forms spaced apart thermal seals along at least
2 one moving web by contact of the moving at least one web with heated portions
3 of sealing elements mounted on a sealing wheel during rotation comprising:
4 seal forming elements which peripherally contact the at least one
5 web to form the thermal seals by heat transfer to the at least one web; and
6 wherein
7 each seal forming element has an outer section on which is located
8 at least one electrical heater, an inner section which contacts the sealing wheel
9 and an intermediate section which includes thermal insulation which insulates the
10 outer section from the inner section.

1 2. A sealing system in accordance with claim 1 wherein:
2 each electrical heater is comprised of an electrical resistance
3 disposed along a longitudinal dimension of the outer section of the seal forming
4 element, the electrical resistance being distributed along the longitudinal
5 dimension with a higher electric resistance being adjacent to a part of the
6 intermediate section through which heat flows to the inner section and a lower
7 electrical resistance which is disposed adjacent to the thermal insulation of the
8 intermediate section.

1 3. A sealing system in accordance with claim 2 wherein:
2 the inner section of each seal forming element is joined to upper
3 and lower parts of the sealing wheel which are separated on an axis of rotation of
4 the wheel; and
5 the higher electrical resistance is located proximate to the upper
6 and lower parts of the wheel and the lower electrical resistance separates the
7 higher electrical resistance proximate to the upper and lower parts.

1 4. A sealing system in accordance with claim 1 wherein:
2 each seal forming element is radially adjustable to vary the spacing
3 between the spaced apart thermal seals.

1 5. A sealing system in accordance with claim 2 wherein:
2 each seal forming element is radially adjustable to vary the spacing
3 between the spaced apart thermal seals.

1 6. A sealing system in accordance with claim 3 wherein:
2 each seal forming element is radially adjustable to vary the spacing
3 between the spaced apart thermal seals.

1 7. A sealing system in accordance with claim 1 wherein:
2 each electrical heater comprises a film electrical resistance.

1 8. A sealing system in accordance with claim 7 wherein:
2 a pair of film electrical resistances are disposed on opposed
3 surfaces of each outer section and a seal forming surface touches the moving at
4 least one web, is opposed to the thermal insulation and intersects the opposed
5 surfaces of the outer section.

1 9. A sealing system in accordance with claim 2 wherein:
2 each electrical heater comprises a film electrical resistance.

1 10. A sealing system in accordance with claim 9 wherein:
2 a pair of film electrical resistances are disposed on opposed
3 surfaces of each outer section and a seal forming surface touches the moving at
4 least one web, is opposed to the thermal insulation and intersects the opposed
5 surfaces of the outer section.

1 11. A sealing system in accordance with claim 3 wherein:
2 each electrical heater comprises a film electrical resistance.

1 12. A sealing system in accordance with claim 11 wherein:
2 a pair of film electrical resistances are disposed on opposed
3 surfaces of each outer section and a seal forming surface touches the moving at
4 least one web, is opposed to the thermal insulation and intersects the opposed
5 surfaces of the outer section.

1 13. A sealing system in accordance with claim 4 wherein:
2 each electrical heater comprises a film electrical resistance.

1 14. A sealing system in accordance with claim 13 wherein:
2 a pair of film electrical resistances are disposed on opposed
3 surfaces of each outer section and a seal forming surface touches the moving at
4 least one web, is opposed to the thermal insulation and intersects the opposed
5 surfaces of the outer section.

1 15. A sealing system in accordance with claim 5 wherein:
2 each electrical heater comprises a film electrical resistance.

1 16. A sealing system in accordance with claim 15 wherein:
2 a pair of film electrical resistances are disposed on opposed
3 surfaces of each outer section and a seal forming surface touches the moving at
4 least one web, is opposed to the thermal insulation and intersects the opposed
5 surfaces of the outer section.

1 17. A sealing system in accordance with claim 6 wherein:
2 each electrical heater comprises a film electrical resistance.

1 18. A sealing system in accordance with claim 17 wherein:
2 a pair of film electrical resistances are disposed on opposed
3 surfaces of each outer section and a seal forming surface touches the moving at
4 least one web, is opposed to the thermal insulation and intersects the opposed
5 surfaces of the outer section.

1 19. A sealing system in accordance with claim 1 wherein:
2 the outer section is parallel to an axis of rotation of the sealing
3 wheel and the electrical heater extends longitudinally along the outer section.

1 20. A sealing system in accordance with claim 2 wherein:
2 the outer section is parallel to an axis of rotation of the sealing
3 wheel and the electrical heater extends longitudinally along the outer section.

1 21. A sealing system in accordance with claim 3 wherein:
2 the outer section is parallel to an axis of rotation of the sealing
3 wheel and the electrical heater extends longitudinally along the outer section.

1 22. A sealing system in accordance with claim 4 wherein:
2 the outer section is parallel to an axis of rotation of the sealing
3 wheel and the electrical heater extends longitudinally along the outer section.

1 23. A sealing system in accordance with claim 7 wherein:
2 the outer section is parallel to an axis of rotation of the sealing
3 wheel and each electrical resistance extends longitudinally along the outer
4 section.

1 24. A sealing system in accordance with claim 8 wherein:
2 the outer section is parallel to an axis of rotation of the sealing
3 wheel and each electrical resistance extends longitudinally along the outer
4 section.

1 25. A process for forming spaced apart thermal seals along a moving at
2 least one web by contact of the moving the at least one web with heated portions
3 of sealing elements mounted on a sealing wheel during rotation having seal
4 forming elements which peripherally contact the at least one web to form the
5 thermal seals by heat transfer to the at least one web and wherein each seal
6 forming element has an outer section on which is located at least one electrical
7 heater, an inner section which contacts the sealing wheel and an intermediate
8 section which includes thermal insulation which insulates the outer section from
9 the inner section and each electrical heater is comprised of an electrical
10 resistance disposed along a longitudinal dimension of the outer section of the
11 seal forming element, the electrical resistance being distributed along the
12 longitudinal dimension with a higher electrical resistance being adjacent to a part
13 of the intermediate section through which heat flows to the inner section and a
14 lower electrical resistance which is disposed adjacent to the thermal insulation of
15 the intermediate section comprising:

16 applying an electrical potential to each electrical resistance to heat
17 the seal forming elements at a point of moving contact with the at least one web
18 to form the spaced apart thermal seals on the moving web.

1 26. A process in accordance with claim 25 wherein:

2 the inner section of each electrical heater is joined to upper and
3 lower parts of the wheel which are separated along an axis of rotation of the
4 wheel and the higher electrical resistance is located proximate to the upper and
5 lower parts of the wheel and the lower electrical resistance separates the higher
6 electrical resistance proximate to the upper and lower parts; and

7 during rotation of the sealing wheel to form the thermal seals a
8 variation in temperature along a longitudinal dimension of the electrical heater
9 during rotation is less than 30°F.

1 27. A process in accordance with claim 26 wherein:
2 the variation in temperature is less than 15°F.

1 28. A process in accordance with claim 25 further comprising:
2 during rotation of the sealing wheel to form the thermal seals,
3 rotation of the wheel and movement of the at least one web is stopped while the
4 at least one web contacts the periphery of the wheel, the electrical potential is
5 turned off to stop heating produced by current flow through the electrical
6 resistance and seals perpendicular to a longitudinal dimension of the at least one
7 web which are straight and parallel are produced.

1 29. A process in accordance with claim 26 further comprising:
2 during rotation of the sealing wheel to form the thermal seals,
3 rotation of the wheel and movement of the at least one web is stopped while the
4 at least one web contacts the periphery of the wheel, the electrical potential is
5 turned off to stop heating produced by current flow through the electrical
6 resistance and seals perpendicular to a longitudinal dimension of the at least one
7 web which are straight and parallel are produced.

1 30. A process in accordance with claim 27 further comprising:
2 during rotation of the sealing wheel to form the thermal seals,
3 rotation of the wheel and movement of the at least one web is stopped while the
4 at least one web contacts the periphery of the wheel, the electrical potential is
5 turned off to stop heating produced by current flow through the electrical
6 resistance and seals perpendicular to a longitudinal dimension of the at least one
7 web which are straight and parallel are produced.

1 31. A sealing system which forms spaced apart thermal seals along a
2 moving at least one web by contact of the moving at least one web with heated
3 portions of sealing elements mounted on a sealing wheel during rotation
4 comprising:
5 seal forming elements which peripherally contact the at least one
6 web to form the thermal seals by heat transfer; and wherein
7 each seal forming element has an outer section on which is located
8 at least one electrical heater, an inner section which contacts the sealing wheel
9 and an intermediate section which includes thermal insulation which insulates the
10 outer section from the inner section, and the intermediate section has two end
11 projections which separate the outer section from the inner section, each
12 electrical heater is comprised of a film electrical resistance disposed along a
13 longitudinal dimension of the outer section of the seal forming element, the
14 electrical resistance being distributed in a plurality of sections of different
15 electrical resistance along the longitudinal dimension with a higher electrical
16 resistance being at ends of the outer section and at least one lower electrical
17 resistance section which is disposed from the higher resistance sections to a
18 midpoint between the ends.

1 32. A sealing system in accordance with claim 31 wherein:
2 the film electrical resistance is a thick film electrical resistance.

1 33. A sealing system in accordance with claim 31 wherein:
2 the at least one lower electrical resistance section comprises a
3 plurality of lower electrical resistance sections which are disposed symmetrically
4 about the midpoint.

1 34. A sealing system in accordance with claim 32 wherein:
2 the at least one lower electrical resistance section comprises a
3 plurality of lower electrical resistance sections which are disposed symmetrically
4 about the midpoint.

1 35. A sealing system in accordance with claim 33 wherein:
2 the plurality of lower electrical resistance sections comprise a
3 lowest electrical resistance section disposed symmetrically about the midpoint
4 and a pair of electrical resistance sections disposed between the higher electrical
5 resistance sections and the lowest electrical resistance section.

1 36. A sealing system in accordance with claim 34 wherein:
2 the plurality of lower electrical resistance sections comprise a
3 lowest electrical resistance section disposed symmetrically about the midpoint
4 and a pair of electrical resistance sections disposed between the higher electrical
5 resistance sections and the lowest electrical resistance section.

1 37. A sealing system in accordance with claim 31 wherein:
2 at least a pair of film electrical resistances are disposed on opposed
3 surfaces of each outer section and a seal forming surface touches the moving at
4 least one web, is opposed to the thermal insulation and intersects the opposed
5 surfaces of the outer section.

1 38. A sealing system in accordance with claim 32 wherein:
2 at least a pair of film electrical resistances are disposed on opposed
3 surfaces of each outer section and a seal forming surface touches the moving at
4 least one web, is opposed to the thermal insulation and intersects the opposed
5 surfaces of the outer section.

1 39. A sealing system in accordance with claim 33 wherein:
2 at least a pair of film electrical resistances are disposed on opposed
3 surfaces of each outer section and a seal forming surface touches the moving at
4 least one web, is opposed to the thermal insulation and intersects the opposed
5 surfaces of the outer section.

1 40. A sealing system in accordance with claim 34 wherein:
2 at least a pair of film electrical resistances are disposed on opposed
3 surfaces of each outer section and a seal forming surface touches the moving at
4 least one web, is opposed to the thermal insulation and intersects the opposed
5 surfaces of the outer section.

1 41. A sealing system in accordance with claim 35 wherein:
2 at least a pair of film electrical resistances are disposed on opposed
3 surfaces of each outer section and a seal forming surface touches the moving at
4 least one web, is opposed to the thermal insulation and intersects the opposed
5 surfaces of the outer section.

1 42. A sealing system in accordance with claim 36 wherein:
2 at least a pair of film electrical resistances are disposed on opposed
3 surfaces of each outer section and a seal forming surface touches the moving at
4 least one web, is opposed to the thermal insulation and intersects the opposed
5 surfaces of the outer section.

1 43. A thermal sealing element comprising:
2 a support;
3 a film heating element having a resistance to which is applied
4 electric current for generating heat to thermally seal film contacting the heating
5 element; and
6 insulation separating the film heating element from the support.

1 44. A thermal sealing element in accordance with claim 42 wherein:
2 the support is a mounting member which attaches to a movable
3 sealing system.

1 45. A thermal sealing element in accordance with claim 43 wherein:
2 the film resistance is a thick film resistance; and
3 the thick film resistance has a substrate which is a metallic member
4 which is joined to the insulation.

1 46. A thermal sealing element in accordance with claim 44 wherein:
2 the film resistance is a thick film resistance; and
3 the thick film resistance has a substrate which is a metallic member
4 which is joined to the insulation.

1 47. A thermal sealing element in accordance with claim 43 wherein:
2 the insulation is a solid insulation layer which separates the film
3 heating element from the support.

1 48. A thermal sealing element in accordance with claim 44 wherein:
2 the insulation is a solid insulation layer which separates the film
3 heating element from the support.

1 49. A thermal sealing element in accordance with claim 45 wherein:
2 the insulation is a solid insulation layer which separates the
3 substrate from the support.

1 50. A thermal sealing element in accordance with claim 46 wherein:
2 the insulation is a solid insulation layer which separates the film
3 heating element from the support.

1 51. A thermal sealing element in accordance with claim 43 wherein:
2 the insulation comprises a section having a slot providing an air gap
3 between the film heating element and the support with the section having a pair
4 of projections which separate the support from the film heating element and which
5 define ends of the air gap.

1 52. A thermal sealing element in accordance with claim 44 wherein:
2 the insulation comprises a section having a slot providing an air gap
3 between the film heating element and the support with the section having a pair
4 of projections which separate the support from the film heating element and which
5 define ends of the air gap.

1 53. A thermal sealing element in accordance with claim 45 wherein:
2 the insulation comprises a section having a slot providing an air gap
3 between the substrate and the support with the section having a pair of
4 projections which separate the support from the substrate and which define ends
5 of the air gap.

1 54. A thermal sealing element in accordance with claim 46 wherein:
2 the insulation comprises a section having a slot providing an air gap
3 between the film heating element and the support with the section having a pair
4 of projections which separate the support from the film heating element and which
5 define ends of the air gap.

1 55. A thermal sealing element in accordance with claim 43 wherein:
2 the film resistance varies along a length thereof.

1 56. A thermal sealing element in accordance with claim 45 wherein:
2 the thick film resistance varies along a length thereof.

1 57. A thermal sealing element in accordance with claim 47 wherein:
2 the film resistance varies along a length thereof.

1 58. A thermal sealing element in accordance with claim 51 wherein:
2 the film resistance varies along a length thereof.

1 59. A thermal sealing element in accordance with claim 55 wherein:
2 the film resistance is comprised of a plurality of sections with at
3 least two of the sections having a different resistance.

1 60. A thermal sealing element in accordance with claim 56 wherein:
2 the thick film resistance is comprised of a plurality of sections with
3 at least two of the sections having a different resistance.

1 61. A thermal sealing element in accordance with claim 57 wherein:
2 the film resistance is comprised of a plurality of sections with at
3 least two of the sections having a different resistance.

1 62. A thermal sealing element in accordance with claim 58 wherein:
2 the film resistance is comprised of a plurality of sections with at
3 least two of the sections having a different resistance.

1 63. A sealing system which forms spaced apart thermal seals along at
2 least one moving web by contact of the moving at least one web with heated
3 portions of an outside periphery of a sealing wheel during rotation comprising:
4 seal forming elements attached to the sealing wheel which
5 peripherally contact the at least one web to form the thermal seals by heat
6 transfer to the at least one web; and wherein
7 each seal forming element has an outer section which peripherally
8 contacts the at least one web and includes a film resistance electrical heater
9 facing the at least one web and thermal insulation disposed between the outer
10 section and the sealing wheel which insulates the outer section from the sealing
11 wheel.

12 64. A sealing system in accordance with claim 63 wherein:
13 the seal forming elements comprise a first group which we parallel
14 to an axis of rotation of the sealing wheel, and
15 a second group which are disposed circumferentially on an outside
16 periphery of the sealing wheel and are individually disposed between different
17 pairs of adjacent seal forming elements of the first group.

1 65. A sealing system in accordance with claim 64 wherein:
2 the first and second groups are continuous and joined together.

1 66. A sealing system in accordance with claim 63 wherein:
2 the film resistance is a thick film resistance which varies along a
3 longitudinal dimension thereof.

1 67. A sealing system in accordance with claim 66 wherein:
2 the thick film resistance of each sealing element is comprised of a
3 plurality of sections of resistance with at least two of the sections being of a
4 different resistance.

1 68. A sealing system in accordance with claim 63 wherein:
2 the film resistance is a thick film resistance which varies along a
3 longitudinal dimension of at least one of the first and second groups.

1 69. A sealing system in accordance with claim 68 wherein:
2 the thick film resistance is comprised of a plurality of sections of
3 resistance with at least two of the sections being of a different resistance in at
4 least one of the first and second groups.

1 70. A sealing system in accordance with claim 64 wherein:
2 the film resistance is a thick film resistance which varies along a
3 longitudinal dimension of at least one of the first and second groups.

1 71. A sealing system in accordance with claim 70 wherein:
2 the thick film resistance is comprised of a plurality of sections of
3 resistance with at least two of the sections being of a different resistance in at
4 least one of the first and second groups.

1 72. A sealing system in accordance with claim 65 wherein:
2 the film resistance is a thick film resistance which varies along a
3 longitudinal dimension of at least one of the first and second groups.

1 73. A sealing system in accordance with claim 72 wherein:
2 the thick film resistance is comprised of a plurality of sections of
3 resistance with at least two of the sections being of a different resistance in at
4 least one of the first and second groups.

1 74. A sealing system in accordance with claim 64 wherein:
2 the first group includes at least one section of resistance disposed
3 between ends thereof which is wider than the resistance at the ends which
4 produces a seal dividing a container defined between adjacent elements of the
5 first group and an element of the second group into at least two sections with the
6 at least one section of resistance which is wider between adjacent elements
7 producing a seal defining an opening into one of the at least two sections.

1 75. A sealing system in accordance with claim 65 wherein:
2 the first group includes at least one section of resistance disposed
3 between ends thereof which is wider than the resistance at the ends which
4 produces a seal dividing a container defined between adjacent elements of the
5 first group and an element of the second group into at least two sections with the
6 at least one section of resistance which is wider between adjacent elements
7 producing a seal defining an opening into one of the at least two sections.

1 76. A sealing system in accordance with claim 66 wherein:
2 the first group includes at least one section of resistance disposed
3 between ends thereof which is wider than the resistance at the ends which
4 produces a seal dividing a container defined between adjacent elements of the
5 first group and an element of the second group into at least two sections with the
6 at least one section of resistance which is wider between adjacent elements
7 producing a seal defining an opening into one of the at least two sections.

1 77. A sealing system in accordance with claim 67 wherein:
2 the first group includes at least one section of resistance disposed
3 between ends thereof which is wider than the resistance at the ends which
4 produces a seal dividing a container defined between adjacent elements of the
5 first group and an element of the second group into at least two sections with the
6 at least one section of resistance which is wider between adjacent elements
7 producing a seal defining an opening into one of the at least two sections.

1 78. A sealing system in accordance with claim 68 wherein:
2 the first group includes at least one section of resistance disposed
3 between ends thereof which is wider than the resistance at the ends which
4 produces a seal dividing a container defined between adjacent elements of the
5 first group and an element of the second group into at least two sections with the
6 at least one section of resistance which is wider between adjacent elements
7 producing a seal defining an opening into one of the at least two sections.

1 79. A sealing system in accordance with claim 69 wherein:
2 the first group includes at least one section of resistance disposed
3 between ends thereof which is wider than the resistance at the ends which
4 produces a seal dividing a container defined between adjacent elements of the
5 first group and an element of the second group into at least two sections with the
6 at least one section of resistance which is wider between adjacent elements
7 producing a seal defining an opening into one of the at least two sections.

1 80. A sealing system in accordance with claim 70 wherein:
2 the first group includes at least one section of resistance disposed
3 between ends thereof which is wider than the resistance at the ends which
4 produces a seal dividing a container defined between adjacent elements of the
5 first group and an element of the second group into at least two sections with the
6 at least one section of resistance which is wider between adjacent elements
7 producing a seal defining an opening into one of the at least two sections.

1 81. A sealing system in accordance with claim 71 wherein:
2 the first group includes at least one section of resistance disposed
3 between ends thereof which is wider than the resistance at the ends which
4 produces a seal dividing a container defined between adjacent elements of the
5 first group and an element of the second group into at least two sections with the
6 at least one section of resistance which is wider between adjacent elements
7 producing a seal defining an opening into one of the at least two sections.

1 82. A sealing system in accordance with claim 72 wherein:
2 the first group includes at least one section of resistance disposed
3 between ends thereof which is wider than the resistance at the ends which
4 produces a seal dividing a container defined between adjacent elements of the
5 first group and an element of the second group into at least two sections with the
6 at least one section of resistance which is wider between adjacent elements
7 producing a seal defining an opening into one of the at least two sections.

1 83. A sealing system in accordance with claim 73 wherein:
2 the first group includes at least one section of resistance disposed
3 between ends thereof which is wider than the resistance at the ends which
4 produces a seal dividing a container defined between adjacent elements of the
5 first group and an element of the second group into at least two sections with the
6 at least one section of resistance which is wider between adjacent elements
7 producing a seal defining an opening into one of the at least two sections.

1 84. A sealing system which forms spaced apart thermal seals between at
2 least two webs by contact of the at least two webs with heated seal forming
3 elements comprising:
4 a pair of seal forming elements which contact opposed sides of the
5 at least two webs to form the thermal seals by heat transfer to the at least one
6 web; and wherein
7 each of the pair of seal forming elements has a first section which
8 contacts one of at least two webs and includes a film resistance electrical heater
9 facing one of the at least two webs and thermal insulation disposed between the
10 first section and a second section which is spaced farther from the at least two
11 webs than the first section with the seal forming elements having a closed
12 periphery for containing a substance inside the closed periphery between the at
13 least two webs.

1 85. A sealing system in accordance with claim 84 wherein:
2 the resistance is a thick film resistance and the insulation is a
3 plurality of slots located at different sides of each seal forming element with each
4 slot providing an air gap between the film heating element and the second
5 section.

1 86. A sealing system in accordance with claim 84 wherein:
2 the resistance is a thick film resistance and the insulation is a
3 peripheral ring of thermal insulation extending around a periphery of each seal
4 forming element.

1 87. A sealing system in accordance with claim 1 wherein:
2 the electrical heater is a film resistance disposed on a surface of the
3 outer section which contacts the at least one web.

1 88. A sealing system in accordance with claim 2 wherein:
2 the electrical heater is a film resistance disposed on a surface of the
3 outer section which contacts the at least one web.

1 89. A sealing system in accordance with claim 3 wherein:
2 the electrical heater is a film resistance disposed on a surface of the
3 outer section which contacts the at least one web.

1 90. A sealing system in accordance with claim 4 wherein:
2 the electrical heater is a film resistance disposed on a surface of the
3 outer section which contacts the at least one web.

1 91. A sealing system in accordance with claim 5 wherein:
2 the electrical heater is a film resistance disposed on a surface of the
3 outer section which contacts the at least one web.

1 92. A sealing system in accordance with claim 6 wherein:
2 the electrical heater is a film resistance disposed on a surface of the
3 outer section which contacts the at least one web.

1 93. A process in accordance with claim 25 wherein:
2 the electrical heater is a film resistance disposed on a surface of the
3 outer section which contacts the at least one web.

1 94. A process in accordance with claim 26 wherein:
2 the electrical heater is a film resistance disposed on a surface of the
3 outer section which contacts the at least one web.

1 95. A process in accordance with claim 27 wherein:
2 the electrical heater is a film resistance disposed on a surface of the
3 outer section which contacts the at least one web.

1 96. A process in accordance with claim 28 wherein:
2 the electrical heater is a film resistance disposed on a surface of the
3 outer section which contacts the at least one web.

1 97. A sealing system in accordance with claim 31 wherein:
2 the electrical heater is a film resistance disposed on a surface of the
3 outer section which contacts the at least one web.

1 98. A sealing system in accordance with claim 32 wherein:
2 the electrical heater is a film resistance disposed on a surface of the
3 outer section which contacts the at least one web.

1 99. A sealing system in accordance with claim 33 wherein:
2 the electrical heater is a film resistance disposed on a surface of the
3 outer section which contacts the at least one web.

1 100. A sealing system in accordance with claim 35 wherein:
2 the electrical heater is a film resistance disposed on a surface of the
3 outer section which contacts the at least one web.

- 1 101. A sealing system in accordance with claim 37 wherein:
- 2 the electrical heater is a film resistance disposed on a surface of the
- 3 outer section which contacts the at least one web.